Clopyralid in Turfgrass Clippings: Formulation and Mowing Effects on Dissipation

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Introduction

During the spring and summer of 2000, injury to garden plants in eastern Washington was traced to clopyralid-contaminated compost produced by a facility near Spokane. The source of the clopyralid was identified as grass clippings removed from residential and other landscape areas (Bezdicek, et al., 2001). Previous data and subsequent research have shown that clopyralid does not break down completely during the composting process (Vandervoort et al., 1997).

Objective

To evaluate methods to reduce clopyralid concentration in turfgrass clippings to acceptable levels before the clippings enter a compost stream. Specifically, pesticide formulations and mowing techniques were evaluated in order to identify the length of time necessary until concentrations in collected grass clippings reached acceptable levels.

Methods

Location:
WSU-Puyallup Farm 5 Turfgrass Research Facility; Established turf comprised of dryland bentgrass (*Agrostis castellana*), fine fescue (*Festuca* spp.), perennial ryegrass *(Lolium perenne*) and annual bluegrass (*Poa annua*).

Design:
- 2 x 2 factorial experiment, 3 replications.
- Main factors were pesticide formulation and mowing procedure; [formulation x mowing].
- Main plots divided into 12 sub-plots for individual sampling intervals (assigned randomly).

2 clopyralid formulations:
- Sprayable - Lontrel (clopyralid), applied in 413 L H_20 per ha (44 gal per acre).
- Granular – clopyralid formulated with 12-12-12 fertilizer, applied with drop spreader.
- Clopyralid application rate 0.28 kg ae per ha (0.25 lb ae /a).
- Plots treated with sprayable formulation fertilized at rate equivalent to granular plots.

2 mowing procedures:
- Clippings collected – each week with a rotary mower.
- Clippings mulched – twice weekly (to prevent excessive accumulation) with a rotary mulching mower.
- Height of cut 6.25 cm (2.5 in.)

Harvesting plots with lawn mower

Sampling procedures:
- Sampling times: 0, 0.5, 1, 2, 3, 4, 5, 6, 8, and 10 Weeks After Treatment (WAT)
- 0 WAT sample collected 4 hours after application – material dry on leaf surface.
- 0.5 WAT sample collected 3 days after treatment.
- Additional samples collected from 46 – 56 WAT (summer 2002).
- Separate sub-plots of [formulation x mowing] whole plots were sampled at each designated sampling time. Designated sub-plots were sampled, then all remaining sub-plots were mowed. The only exception to this was the 0 WAT sample, in which only the sub-plots designated for sampling were mowed.
- Samples were collected from 1.8 x 1.8 m (6 ft x 6 ft) sub-plot, mixed, and subsampled for clopyralid and dry mass (moisture content) determination.
- For mulched treatment, clippings were returned to plots at each mowing. The only time clippings were collected from a mulched sub-plot was on the designated sampling date for that sub-plot.
- For clippings collected treatment, clippings were removed from all sub-plots each time the plots were mowed.
- Clopyralid determinations on 5 g samples were conducted by Morse Laboratories, Sacramento, CA, by capillary gas chromatography and mass spectrometry.

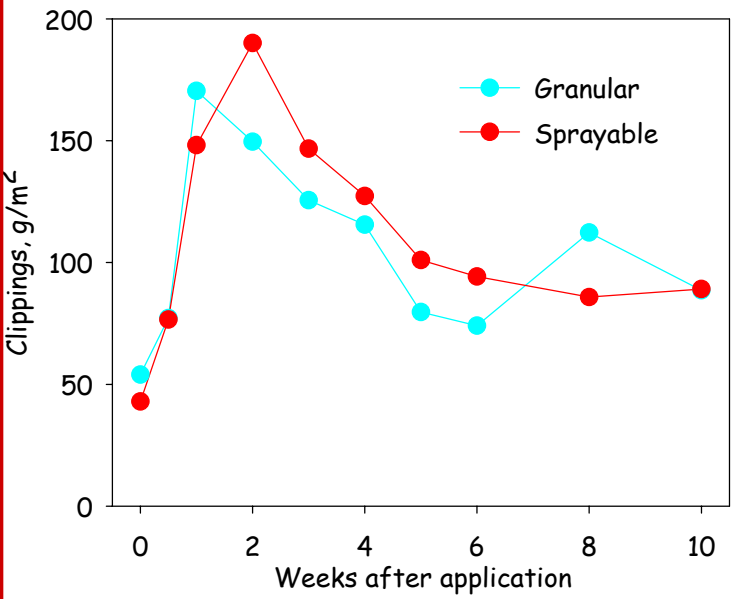

Figure 1. Dry mass of grass clippings collected on each sampling date.

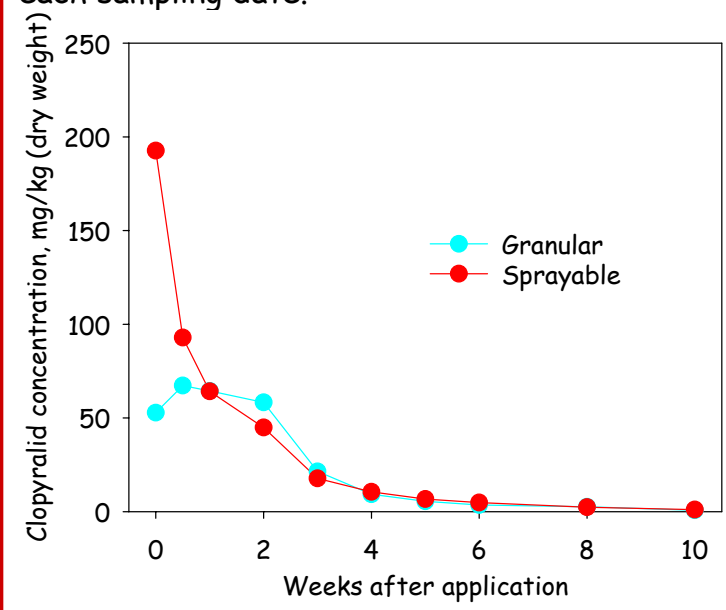

Figure 2. Clopyralid concentration in grass clippings.

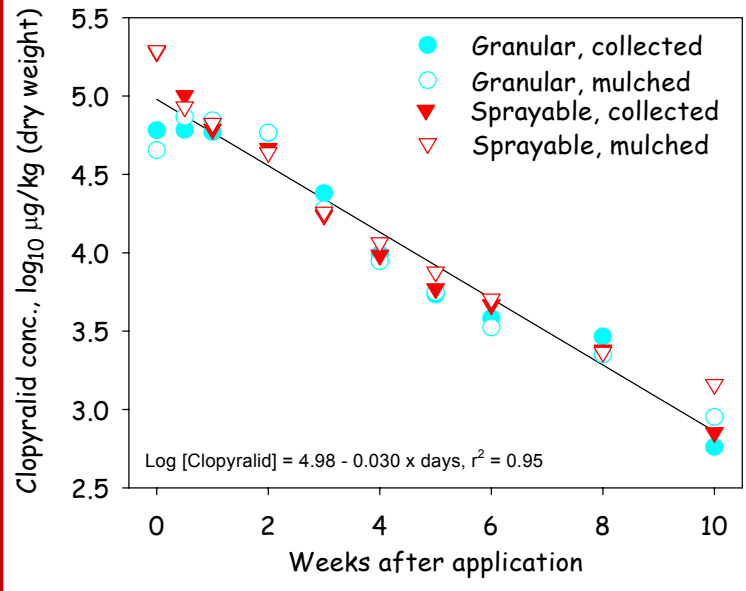

Figure 3. Log_{10} clopyralid concentration in grass clippings.

Results

- There was never a significant [mowing x formulation] interaction. The only significant effects of mowing treatment occurred at 10 WAT (clipping yield, concentration). Therefore, mowing treatments were combined for clarity of presentation.
- Clipping yield followed a pattern consistent with nitrogen application, with highest yields in weeks 1 through 4, declining thereafter (Fig. 1). Neither formulation nor mowing treatment had a consistent significant effect on clipping yield.
- The sprayable formulation resulted in higher clopyralid concentration than the granular at 0 and 10 WAT only (Fig. 2). Initial concentrations were approximately 200 mg kg^{-1} (ppm), declining to 1 mg kg-1 (ppm) by 10 WAT. The injury threshold for susceptible plants is about 0.003 mg/kg (3 ppb) clopyralid.
- Clopyralid concentration in clippings from 0 through 10 WAT followed a logarithmic decline (linear when plotted on a log scale, r^2=0.95) through the sampling period (Fig. 3). Disappearance half life was approximately 10 days.
- The sprayable formulation resulted in significantly higher total recovery than the granular (Fig. 4). This difference was largely due to the higher initial concentration at 0 WAT (Fig. 2). Total clopyralid recoveries in clippings were 29% and 35% for the granular and sprayable formulations, respectively.
- Clipping clopyralid concentration declined to 135 µg kg^{-1} by 46 WAT, and to 62 µg kg^{-1} by 56 WAT (Table 1).

Table 1. Clopyralid concentration (µg kg^{-1} dry weight basis) in turfgrass clippings during 2002.

Date	Weeks after Application (approx)	Clopyralid Concentration
30 May	46	135
12 June	48	132
25 June	50	107
9 July	52	76
24 July	54	81
6 Aug	56	62

Because statistically significant differences due to formulation and mowing treatments were limited during 2001, samples were collected and analyzed from the S formulation – CM plots only during 2002.

Conclusions

Mowing practices had no significant impact on clopyralid content of grass clippings. Higher clopyralid content from the sprayable formulation immediately after application resulted in higher total recovery. From 0 through 10 WAT, both formulations resulted in clipping clopyralid concentrations that were unacceptably high. Based on the results of this research, more than a year would be required for clopyralid content to drop to levels low enough for the turfgrass clippings to have an unrestricted use as a compost feedstock.

References

Bezdicek, D., M. Fauci, D. Caldwell, R. Finch, and J. Lang. 2001. Persistent herbicides in compost. Biocycle 42(7): 25-30.

Vandervoort, C., M.J. Zabik, B. Branham, and D.W. Lickfeldt. 1997. Fate of selected pesticides applied to turfgrass: Effect of composting on residues. Bull. Environ. Contam. Toxicol. 58:38-45.

Quantitative collection of clippings.

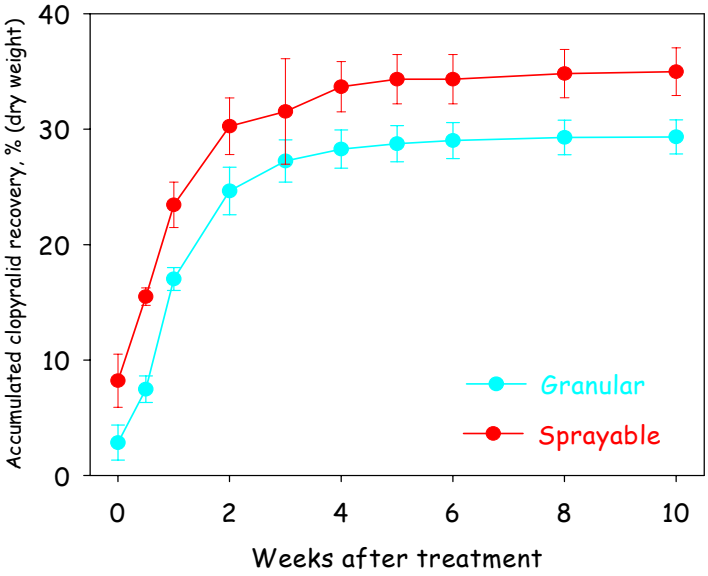

Figure 4. Cumulative clopyralid recovery in harvested grass clippings.

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